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The Adoption of Web Services based Architectures in Australian organisations: An Exploratory Study

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Abstract

This exploratory research study contributes to answering two related research questions. First it identifies the key influences that seem to be driving and constraining the adoption of Service Oriented Architecture (SOA) and XML/Web Services and secondly it adduces some evidence to confirm that these influences significantly differ from those found by IS researchers in the adoption of other innovations in organisations. The key drivers were found to include improved agility, reuse and [open standards enabled] interoperability. None of these map easily to factors identified in previous Diffusion of Innovations (DOI) related IS research. In spite of standards being originally seen as strengths, it was found that the lack of IT industry agreement on the next generation of Web Services standards is now emerging as a perceived constraint. Variants of the 'network effect' such as partner push and client drag were also found to be influential.

Keywords

Web Services, Service Oriented Architecture, Adoption, Constraints, Drivers, Innovation, Standards

INTRODUCTION

A variety of approaches endeavour to improve the efficiency and effectiveness of Enterprise-wide Information Systems development. These include enhancing the organisation's existing enterprise systems via Business Process Management (BPM), Enterprise Application Integration (EAI), Service Oriented Architecture (SOA) and XML/Web Services. This paper reports on an on-going study into the adoption of SOA/Web Services (SOA/WS) by Australian organisations.

SOA as a concept has been in use for over 20 years (Newcomer & Lomow, 2005, p. 149). SOA is an enterprise architecture which aims to decompose complex systems into separate services with precisely defined interfaces, which exchange information in a loosely coupled manner. This means that systems developers need to know nothing or very little about each other's internal implementations. The case for adopting SOA to improve enterprise effectiveness has been extensively documented in numerous textbooks and in the academic literature. The potential benefits include reduced system complexity resulting in easier alignment of business process with technology and greater reuse resulting in cost savings due to lowered development and maintenance costs. Some authors have noted gains in modularity, flexibility and agility, which enable firms to respond more quickly to changing environments, resulting from events such as corporate mergers or sudden demand shifts. Other authors have emphasised the importance of SOA for interoperability and integration (Bloomberg, 2004, ; Krafzig, Banke, & Slama, 2004, ; Newcomer & Lomow, 2005, ; Singh & Huhns, 2005).

The concept of Web Services emerged more recently (around 2000), and is currently seen as the most popular enabling technology for SOA. Compared to proprietary enabling technologies for SOA in the past (e.g. MSMQ, CORBA, RMI and DCOM), the key benefit of Web Services for SOA implementation is their open, vendor

neutral nature and the capacity to carry typed information through interfaces. A number of main industry players have cooperated in agreeing standards for document types (XML), for messaging (SOAP), for service description (WSDL), for service discovery and published directories (UDDI) and more recently for a host of further enhancements. This convergence of industry support is unusual and perhaps explains the rapid rise in popularity of Web Services compared with the much slower uptake of earlier enabling technologies. While they are distinct concepts, SOA and Web Services have become closely intertwined in the literature. In fact, they are blended in generic terms like *Service Oriented Computing*.

From an IT architecture viewpoint, the SOA and Web services concepts hold much promise. In fact, many industry analysts and vendor sources have predicted that Web Services will rapidly assume major strategic significance in enterprise-wide systems development. However, there also appears to be significant doubt in the minds of some organisational IS decision makers whether to adopt the concept for various reasons including immaturity of some of the standards (Koch, 2003, ; Patlak, Bener, & Bingol, 2003).

Even though the level of interest within the IT profession is similar to that which preceded the emergence of the HTTP networking innovation (which enabled the Web and e-Commerce) in the 1990's there is a research gap in our understanding of the SOA/WS innovation and it is not known whether this innovation has attributes which clearly distinguish it from other IS innovations.

An apparent similarity with Intranets and the Internet is the importance in both cases of agreed standards and protocols, a consequence of which is that a *network effect* may be important for SOA/WS as it was in the case of the diffusion of the internet and HTTP networking. A *network effect*, is where providers and users of SOA/WS need to make concurrent adoption decisions (King et al., 1994, ; Oliva, 1994). A similar affinity exists between SOA/WS and EDI, as the latter relies on agreed message standards so that its adoption has been found to involve a *network effect* (Premkumar & Ramamurthy, 1997). From a different perspective SOA/WS appears to share with Object Oriented Technology that both promise improvements to the way that software applications and systems are developed, with a premium on reuse and agility. There have been adoption studies of the Internet (Lyytinen & Rose, 2003), of EDI (Premkumar & Ramamurthy, 1997) and of Object Oriented Technology.

Other innovations which have similarities with SOA/WS are its precursors, namely MQSeries, CORBA, DCOM and RMI. However as no literature was found on the adoption of these innovations, they offer little help for studying the adoption of SOA/WS.

In aiming to address this gap in understanding, the two closely related research questions of this study were:

- (i) What are the key influences (drivers and constraints) determining the enterprise decision to adopt SOA/WS and
- (ii) To what extent are these influences unique to SOA/WS as distinct from other similar Information Technology (IT) innovations?

To answer these questions the researchers undertook exploratory case studies in eight Australian organisations. This paper reports on the early findings from this research and highlights a number of pertinent research implications arising from these findings.

The rest of the paper describes how a conceptual model was developed from the literature on adoption of innovations, explains how the research approach utilised this model, describes the cases, summarises and discusses the findings, and draws on these findings to present some preliminary conclusions.

CONCEPTUAL FRAMEWORK DEVELOPMENT

This section describes how a conceptual framework was developed for studying SOA/WS adoption in organisational contexts. For this the research drew on a number of perspectives from the literature on the organisational adoption of IT innovations.

The adoption and use of a new technology within an organisational context can be regarded as an organisational innovation process (Iivari, 1993, ; Larsen, 1993, ; Swanson, 1994, ; Tornatzky & Klein, 1982, ; Zaltman, Duncan, & Holbek, 1973). An extensive body of literature exists on the adoption and diffusion of innovations (DOI). This includes Rogers' seminal work (Rogers, 1962) and more specifically the adoption of information technology innovations in organisations (Attewell, 1992, ; Cooper & Zmud, 1990, ; Wynekoop & Senn, 1992).

Many authors in diverse disciplines, including Rogers himself, have subsequently adapted the DOI theory as a basis for detailed causal models of how diffusion occurs in organisational contexts and in particular the key attributes that determine technology acceptance or rejection. Rogers (2003) distinguished between the determinants of innovation adoption by organisations and those that influence the adoption by individuals.

Kwon & Zmud (1987) classified the causal influences of organisational innovativeness into five broad groups. More recently Mustonen-Ollila and Lyytinen (2003) identified 29 factors, including both drivers and disablers,

that were found in prior studies (e.g. see Premkumar & Potter, 1995) to correlate with IS innovation adoption. They classified these factors into Kwon & Zmud's five factor-groups: the Innovation, the Environment, the Organisation, the Individual and the Task. The first three groups are shown in Table 1. The factors that correlated most strongly in that study are shown in italics.

Premkumar & Ramamurthy (1997) in a study of EDI adoption in organisations focussed on just these three groups: Innovation, Environmental, and Organisational. They argued that that EDI adoption is an organisational decision unaffected by Individual influences and excluded the Task group based on the inconsistent findings by Kwon & Zmud regarding influence of the Task factors.

A recent study on Web Services adoption in four US finance companies (Ciganek, Haines, & Haseman, 2005) concurred with Premkumar & Ramamurthy, arguing that as for EDI three main factor groupings (Innovation, Environmental, and Organisational) are sufficient.

Like Ciganek et al and Premkumar & Ramamurthy we primarily considered the adoption of SOA/Web Services as an *organisational* decision.

In the present study, the research built on the frameworks of Mustonen-Ollila et al and Premkumar et al. It analysed and compared the factors used in these two studies.

Group	Mustonen-Ollila et al factors	Premkumar et al factors
Innovation	Relative advantage; Compatibility; <i>Ease of use</i> ; Visibility; Trialability; Price; <i>Suitability</i> ; Problem solver; <i>Standard</i> ; <i>Technological edge</i>	Relative-advantage, Compatibility, Complexity, Cost
Environmental	Cultural values; <i>Technological infrastructure</i> ; Community norms; Funding	Competitive pressure, Customer support, Net-dependence, Climate
Organizational	Interpersonal networks and communication channels; Near-peer networks; Informal communication; <i>Past technological experience</i> ; Working teams; Opinion leaders; Interdependence from others; Adopter roles; Management and hierarchy	Top management support, Product Champion, Size

Table 1: Grouping of factors that influence adoption in organisational contexts (Mustonen-Ollila & Lyytinen, 2003, ; Premkumar & Ramamurthy, 1997)

An assessment and concept mapping of the topic domain was carried out based on prior knowledge of the authors and a review of the SOA/WS technical literature. The latter included numerous recent texts that discuss the advantages and constraints of SOA/WS (Barry, 2003, ; Kaye, 2003, ; Krafzig et al., 2004, ; Newcomer & Lomow, 2005, ; Weerawarana, Curbera, Leymann, Storey, & Ferguson, 2005). This assessment suggested the hypothesis that the semantics for describing the influences behind adoption of SOA/WS innovations deviates in many respects from the semantics of traditional DOI as represented by the factors listed in Table 1. Terms like *agility*, *reuse*, *loose coupling*, *security/trust*, *standard protocols*, *transactional integrity*, *performance* and *reliability* (of networks and of services) arise in the SOA/WS technical literature but these have no obvious counterpart in the traditional DOI derived frameworks. Although some of these terms could be subsumed in the *Relative Advantage* factor it was felt that the concept model would be more useful if they were kept explicit.

In the light of the above our conceptual framework augmented the most relevant factors from Premkumar & Ramamurthy (1997) and Mustonen-Ollila and Lyytinen (2003) with some additional ones derived from the SOA/WS technical literature. Our conceptual framework is summarised in Table 2.

The use of the term *influence* instead of *factor* in what follows is intended to emphasise that no attempt was made in the present study to quantify causalities but rather to use qualitative techniques to explore the nature of the little known influences behind SOA/WS adoption or non-adoption. The [#] indicates those influences that were not derived from extant DOI literature sources. We note there was no support, in the additional technical and trade sources we researched, for inclusion of any Task or Individual factors/influences.

Group	Key Influences
Innovation	Cost saving, Relative Advantage, Reuse [#] , Agility [#] , Transactional Integrity [#] , Security [#] , Standards/Interoperability [#]
Organisation	Management support, Organisation Culture [eg resistance to change], Internal champion, Quality of Process & Data [#]
Environment	Network effect [Client/Partner push or drag], Competitive Pressure, Performance [#]

Table 2: Concept framework derived from literature and from concept mapping of topic domain

METHODOLOGY

Case study research is especially appropriate in new topic areas (Darke, Shanks, & Broadbent, 1998, ; Eisenhardt, 1989) and is a research strategy that allows for an in-depth study of phenomena in context (Galliers, 1991, ; Klein & Myers, 1999). The case research strategy was chosen here due to the novelty of the SOA/WS phenomenon and the level of detail that was anticipated with complex adoption decisions in large organisations. The field study reported here was based on an explorative multi-site case study design (Yin 2003) and focused on the SOA/WS adoption decisions of eight organisations in Australia. The case organisations reflect a mixture of public and private ownership, as well as organisational size.

The concept model (Table 2) was used to design a semi-structured interview schedule. In using this schedule the interviewer however ensured that unprompted views were solicited from respondents before prompting with questions derived from the concept model. Face-to-face interviews were conducted with key IT architecture decision makers within the eight case organisations described below. All the interviews were conducted by the same researcher, who transcribed them personally and edited them prior to sending back to the respondents, who were asked to read through and formally confirm the accuracy of the content. Respondents were later invited to comment on the brief case descriptions (see below) and on the preliminary results in relation to their case.

Interviews were complemented with analysis of relevant background documents, web sites and other information provided by respondents (Kwon & Zmud, 1987, ; Yin, 2003).

As the interviews were intentionally semi-structured and free ranging this inevitably meant that the time devoted to the various issues differed from one interview to another. However the interviewer ensured that respondents were consistently asked for their views regarding the main influences (drivers and constraints) on SOA/WS adoption. They were all asked also to identify the main agents for change within their organisation and whether they considered SOA/WS to be a *disruptive innovation*, defined as one that will cause a major, discontinuous change in organisational behaviour rather than influencing the latter in a gradual evolutionary way. Lyytinen & Rose (2003) describe disruptive innovations as ones that “strongly influence the future trajectory of the adoption and use of ICT in organizational contexts and make the trajectory deviate from its expected course”

As this was only an exploratory investigation a simple manual coding approach was adopted instead of using automated analysis tools. The typed transcripts were integrated into one MS Word document and the analysis involved searching this document for the key concepts, drivers and constraints.

Case Selection Procedure

There is no evidence to indicate that the uptake of SOA/WS is concentrated in certain industries in the way that EDI adoption, for example, tends to be high in the transport or finance sector (Premkumar & Ramamurthy, 1997). The research question thus sought to explore the determinants of adoption per se and not just within any specific industry sector. It was deemed important to capture views across a number of industry sectors but also to get multiple views within at least one specific sector. To achieve the latter goal three cases were identified within the government sector. To get some diversity in company size two large firms and three SME firms were selected within the private sector, all from different industries. Another criterion in selecting respondents was that they were in a position to provide an overview of perceptions within their industry as a whole, thus extending the perspective beyond just the chosen organisation.

The researchers were well placed to identify a core of pertinent organisations and industry contacts via SOA/WS related professional committees which they were active in and were then able to extend this list via a *snowball* sampling approach. A list of organisations which were either considering or had adopted SOA/WS was thus generated. This list was augmented with a scan of the IT press and a sample frame of some forty probable adopters was drawn up. This list led to a contact list mainly of experienced IT architects or consultants within

organisations that were involved in SOA or WS planning or implementation. These were contacted by phone to clarify the extent of their organisation's involvement in SOA/WS. If their activity was considered to be relevant, they were asked to participate in the study. Most of those approached agreed to do so.

All interviewees were practitioners with over 10 years IT industry experience but none was at senior executive management level. Their organisations had all been involved in development of or planning of SOA/WS architectures and had spent a substantial part of the last three years engaged in this. Of the interviewees, two were designated IT Managers, four were Enterprise Architects and two were consultant architects.

Three of the organisations were within government departments, two were large companies (one multinational) and three were medium sized firms. The private firms were in the automotive, financial, service, electrical manufacturing and agricultural industries respectively. Two of the Government departments already had mission critical applications using Web Services. The third was on the crest of implementing various SOA/WS projects.

It should be noted that the case selection strategy adopted here contrasts with that of Ciganek et al (2005) who chose all their four sample cases from the finance sector to reduce cross-case differences via case concentration.

DESCRIPTION OF CASES

The eight cases are summarised below. For each a brief description of the organisation and the key SOA/WS projects is presented. This is followed by an overview of the key drivers and constraints mentioned by respondents in relation to these projects.

Gov1

This is a large government department which is a traditional mainframe site and has two key SOA/Web Services initiatives nearing implementation. The first is a Web Service feed to external clients via a third party provider and the second is development of a *common client layer* encoded for directly delivered services, which is being built for one internal client but with a second pending and possibly others. In addition an interoperability initiative important for future SOA designs is being implemented.

The key perceived drivers are increased agility, which in turn will reduce cost, simplifying the management of IT by “moving from fragile tightly bound environment to a more motile loosely bound one”. The two main constraints are perceived as agreement on application *semantics*, which can be “overcome by mapping the names until all parties agree” and agreement on *ownership* of services “I paid for this so I control it! Right?”.

Additional constraints are management and client doubts – “Why are **you** doing this?” and residual concerns about the maturity of the technology. At present all development uses Java but “we realise that an organisation of this size cannot survive with a single thread application development portfolio. So we have recently published .NET specifications.”

Gov2

This Government organisation has been outsourcing development since 1998 to various consulting organisations.

The key mainframe-based system went live over 12 years ago, but has been radically transformed since then first using host services and more recently Web Services. The Web Service feeds come in part from a federal agency which provides access to data in other major contributing sites much faster than previous systems had done. This system averages 6000 users on-line at any one time.

A key feature is a Web Services based mobile data service network project which “runs on a Push and Pull model”. Mobile Data Terminals pull information from both internal and partner back-ends and one key partner proactively pushes urgent information from a dispatch system.

The key drivers for Web Services include cost saving, reuse and improved interoperability; enabling much faster and more reliable data access via web services based federation of data.

The most important constraints mentioned were tool choice - whether to use .NET or J2EE - and the lack of semantic standards for data representation. Security issues were also crucial but it was felt that the emerging WS standards are proving to be adequate. “We are one of the first adopters of WS-Security”.

Scalability was also initially a big issue but was overcome by “throwing hardware at it”. Transaction semantics were not essential in a business sense so that while their absence (in terms of available implementations) in the current Web Services spectrum is a weakness, it is not critical. *Bandwidth* is not an issue as the system uses Government networks, which are safe and high capacity.

Gov3

This entity is a division of a large government department which has implemented diverse Web Services in various applications. Even though there is as yet no agreement on an enterprise-wide SOA, some reuse of these services across various applications has occurred.

The large mission critical application that the entity has full ownership of has led the way with Web Services but some other applications within the department are following, including one very large project. The first project processes over a million critical transactions per month and has been operational for some years. The larger project, which will reuse some of the Web Services from the first project, is nearing completion. The following comments all pertain to the first project.

The prime drivers included agility (positioning for the future) and reuse and a leadership position taken by a key consultant as advocate. Cost saving was not a driver. The upgrade to Web Services cost almost as much again as the original project but is now perceived as secure, moderate risk and very cost effective even though there were some initial sceptics. The third and fourth key constraints were fear of poor client uptake, which in fact has proved to be unfounded, and an alignment conflict between the Microsoft .NET platform used to develop the application and the departmental IT strategy, which prefers J2EE over .NET development.

SME1

This SME in the auto industry uses an SAP back-end but has had a Microsoft development environment for the past 8 years. The organisation has used Web Services for a variety of projects, with mixed outcomes. The main project, which is perceived to be successful, is not an SOA but uses Web Services extensively.

This main project integrates with a major finance company and a key driver was the hope that it will be leveraged to further clients in future. It is comprised of a system of messages between the consigner of vehicles and the agent who sells them - about 15 message types in all that cover every step of the cycle, though not as a composite service.

A key perceived driver for Web Services adoption, in addition to client demand, is interoperability – to run lean processes with minimised waste in rekeying, which requires automated communications. “The intermediate goal is **higher quality** which then yields lower cost because you have fewer errors and less rework”. Some in the organisation saw an opportunity to create barriers to prevent client switching but this is not universally accepted. There have only been relatively minor constraints such as some mismatch of thinking at partner end but this was solved by loose coupling their system. A possible future constraint, which may involve a rethink about the existing .NET application, is the push to move to a single SAP based server for all the integration. Immaturity of standards was seen as an issue also but concerns about transactions and security are only seen as a minor constraint and bandwidth not at all.

SME2

This SME is a services industry leader that provides customer service solutions, such as call-centres, to large and small clients in many industries. To maintain a competitive advantage through state-of-the-art ICT technologies, the SME has for some years been using the real-time interaction program suite from Genesys Laboratories.

Web Services are being used both internally and in external interactions with clients.

Genesys has recently enhanced its suite incorporating XML Web Services and has encouraged all its users to upgrade. When customers of the SME's many clients phone a call-centre, the new software uses *internal* Web Services in real time to automatically populate a customer *active desktop* (AD). Genesys provides the back-end server but the AD front-end is being built in-house using .NET. In addition a few clients of the SME, who have independently been exploring Web Services, have built *external* Web Services interfaces to the AD. Vendor-push has been an effective driver because the organisation also perceives that Web Services being an accepted standard provide a competitive advantage: “we are the first customer in Australia”.

The main perceived constraint to date has been the cost of achieving interoperability with clients. This was partly due to differences between .NET and J2EE implementations, which has now been overcome. In one case failure in interoperability is to do with the complexity of the network connection which has too many potential points of failure. Another facet of this was inadequacy of client systems documentation.

Large1

This US based Fortune 500 agricultural company, with a major Australian presence since 1968, agreed a long term three phase strategic plan for E-Commerce growth in 2000. The first phase of the plan was Customer Self

Service (CSS), the second was Web-based order management and the third was full B2B integration. So far only Phase 1 has been implemented using SOA and later upgraded to use Web Services, but uptake of Phase 1 by clients has been poor and so the strategy is currently under review.

The system is somewhat unusual in that clients actually access services via a broker in the US, which is federated via Web Services to the Australian server. This design element has been a cause of unpredictable response times but the network infrastructure has recently been upgraded to improve response time consistency.

Originally, the perceived influences for adoption included vendor push and some strategic push from Head Office in 2000, when e-commerce was still high profile. There was also a desire for agility as management wanted to be ready if clients started to push for SOA, which in fact they still have not. Interoperability is a driver globally but in Australia there are only a few key players so this is less relevant than elsewhere. There is an SOA strategic plan being developed around Business Processes which could become a driver in years ahead. The main constraint mentioned has been lack of client take up. Major clients find using the phone more convenient. Some network performance problems have become an issue but these have now been resolved.

Large2

This major finance organisation has built over 100 Services on the MQ Series messaging framework since 2000 and first investigated Web Services in 2003. Development of Web Services is in progress but none are yet fully implemented. A key internal project which has an SOA flavour, without being labelled as such, is delivering customer information applications to branches.

The perceived drivers for SOA/WS are improvements in business agility and time to market, longer term cost reductions and opening up new business capabilities around B2B. The respondent, who is the main advocate of SOA/WS in the organisation, expressed the view that young graduates are important for infusing new thinking and can assist with “people change management aspects associated with paradigm shifts, as happened with the introduction of Object-Oriented technology”. Reported constraints slowing down the adoption of SOA/WS are complexity (such as proliferation of standards), security including identity management, change management of people skills, services contract issues and issues with versioning of schemas.

SME3 (Non adopter)

This leading Australian manufacturer of electrical products has not implemented SOA/WS yet but has been seriously evaluating this option for a number of years. The firm is a large SME with two discrete groups of clients. The first is a diverse range of wholesalers and the second is a smaller group of large direct buyers. The latter appear more likely candidates for SOA/WS adoption since they have a more concise product range and a greater likelihood of commitment to the emerging standards. The organisation has paved the way for innovation with a successfully implemented browser-based call-centre, which has raised the in-house profile of IT.

Since 2003 the firm has used a broker service to interchange data with the wholesale clients and since most partners use the same broker, this arrangement appears to satisfy all parties. “If we are having a problem then broker sorts it out”. Thus there is little pressure to move to open standards.

The firm has had EDI for 10 years and the Internet has replaced the dedicated connection so transmission costs and support costs are lower than before. However they recognise that if the industry could agree on open standards this would have longer term advantages for all. The constraint to this is that most partners and competitors are far from ready. Only one industry supplier offers CSS and then only for a small client set.

The perceived drivers for SOA/WS have been outweighed to date by the constraints. The drivers include vendor push, presence of an internal champion/enthusiast and the likely business benefits for the, more receptive 'direct buyer' client group. The constraints include “...client and industry unreadiness and the lack of a strong enough business case....The concept is terrific but so far we have not seen the business drivers coming back to us.”

SUMMARY OF FINDINGS AND DISCUSSION

Tables 3 and 4 below summarise the respondent views as coded from the transcripts. The number of dots in each cell is an indication of the emphasis placed by the respondents. A blank indicates that the influence was not explicitly mentioned even after prompting.

A significant finding was the indicative evidence that the adoption influences are different for SOA/WS than for other IT innovations that have been studied by IS researchers. This suggests an affirmation of the second research question. Furthermore some of the unique drivers, notably *standards/interoperability* and *agility/reuse* appear to be very important influences.

Other unique influences like *security* and *transactional integrity* seem to be less significant than expected.

The three-fold classification (*Innovation, Environment and Organisation*) seems useful overall as a way of segmenting the influences but there were some exceptions (eg *standards, performance and quality*) that did not fit neatly into a single group. For example *Standards* as driver is an *Innovation* feature but as a constraint it is a feature of an immature *Environment* in which the various standards bodies are vying. Vendor accord regarding the core Web Services standards XML and SOAP enables *interoperability*, which is a feature of the *Innovation* and not the *Environment*.

With this caveat in mind, the findings are discussed below with reference to the three-fold grouping.

Findings on Innovation influences

Group	Influence	Gov1	Gov2	Gov3	SME1	SME2	Large1	Large2	SME3 (non adopter)
<i>Innovation</i>	Cost saving				●●	●●		●●	
	Relative Advantage [eg Reduced Complexity]	●●●		●		●●			
	Reuse	●●	●●	●●●	●●	●●			
	Future Agility &/or time to market	●●●	●●●	●●●	●●●	●●●		●●●	●
	Standards/ Interoperability	●●●	●●●	●●●		●●●	●●●	●	●●
<i>Organisation</i>	Head Office Push				●●		●●		
	Internal champion (eg consultant)	●●	●	●●●	●●●	●	●●	●●●	●●
	Process & Data Quality		●●●	●●●	●●●				
<i>Environment</i>	Network effect [partner or Federation push]	●	●●●		●●●	●●	●●●	●●	
	Vendor Push	●				●●●	●		●●
	Competitive Pressure					●●●	●	●	

Table 3: Comparison of Key Drivers Web Services adoption in various Australian organisations

Agility and *standards* emerged as the two most often cited influences. The potential gain from agility was seen as speed to market and competitive advantage. *Reuse* being an enabler of agility was often mentioned in the same context. These two influences are closely associated.

The benefit from re-use was seen as development cost saving and reduced complexity as well as enabling agility. Re-use has been achieved in a number of cases.

Group	Influence	Gov1	Gov2	Gov3	SME1	SME2	Large1	Large2	SME3 (non adopter)
<i>Innovation</i>	Transactional Integrity		●					●	
	Security	●	●●	●	●	●	●	●●	
	Complexity [eg Scalability]	●	●●					●●	
<i>Organisation</i>	Culture [eg Internal client change issues]	●						●●	
	Management doubts [eg re funding or value]	●●		●●●	●●		●●	●●	
	Lack of champion						●●		
	Organisational issues [who owns services, standards?]	●●		●●				●	
<i>Environment</i>	Network effect: Partners not ready [eg incompatible, poor documentation]	●●		●●		●●	●●●		●●●
	Industry not ready				●		●●●		●●●
	Standards not ready [eg for semantics, service or network management]	●●	●●●	●●	●●			●●●	
	Performance issues [eg of Network]					●●	●●●		

Table 4: Comparison of Key Constraints to Web Services adoption in various Australian organisations

The benefits of improved interoperability associated with standards were often mentioned. Most respondents felt that Web Services can help bridge the gap between operating systems, between database systems and between the J2EE and .NET development environments, which can thus coexist as implementation technologies. Some respondent organisations prefer to remain with either J2EE or .NET but at least three are creating skills in both.

Though most respondents expressed at least mild concern about the security risks associated with services across open networks, most felt that current solutions to security are adequate for now, so that immaturity of WS-Security standards is not perceived to be a major constraint.

Cost savings were cited by less than half of respondents and even these felt that long term savings come at the expense of a short term increase in cost, which can make the case to management difficult since the current industry mood is IT expenditure averse.

Surprisingly few respondents seemed concerned that transactional integrity standards had not yet been agreed. Scalability was mentioned as a constraint once but “was overcome by throwing hardware at it”.

Findings on Organisational influences

The *internal champion* emerged as a key influence in many cases. In some instances the champion was in-house and in three cases it was a trusted consultant. This finding is consistent with previous IS literature (Howell & Higgins, 1990, ; Maidique, 1980).

Improvements in the organisation's *data quality* (due to increased automation) were mentioned as a driver by three respondents. This was not anticipated in the concept model.

Management doubt and uncertainty about the value of IT innovations and reluctance to provide funding was cited by numerous respondents as a constraint. This is a variant of the *top-management support* factor and the finding may need further clarification.

Two constraints related to *organisation culture* were change management concerns and confusion about ownership and charging for internal services.

Findings on External influences

The most salient finding relates to **standards**. Ironically even though the agreement on basic open Web Services standards like SOAP and WSDL has been one of the key drivers, an important constraint is now perceived to be the lack of IT industry agreement on Web Services standards for reliable messaging, services management and business process orchestration. One respondent thought that we were “Drowning in standards” but another felt that in spite of the “hundred standards of which over 70 are still not finalisedthis is a natural process and they are created for reasons which invariably have a sound underpinning”

Various influences (drivers and constraints) were mentioned that are variants of the *network effect*. Drivers included vendor push and push from partners such as clients, peers in a federation or the industry itself. Just as often however partners or the industry as a whole were seen as a constraint due to ‘not being ready’.

Performance (eg network service level) constraints were cited twice. Respondents mentioned the need to manage and monitor Web Service use better to ensure that service and network use is optimised.

CONCLUSION

This exploratory research study has made a contribution to answering both research sub-questions. First it identified key perceived drivers and constraints influencing an enterprise decision to adopt SOA/WS and secondly it provided an indication that the hypothesis that some of *these key influences are indeed unique to SOA/WS and distinct from other similar Information Technology innovations*.

The most dominant drivers were improved *agility*, *reuse* and *interoperability* made possible by open standards. All of these are distinct from the kinds of factors that have been studied in IS organisational research. In order to retain the link with prior research, *agility and reuse* could arguably be considered to be attributes of the overarching concept of *Relative Advantage*. However doing so could obscure the fact that these are particularly strong influences in their own right. Variants of the *network effect* such as partner push or client drag were important as was vendor push in two cases. The finding of Ciganek et al (2005) that a dominant constraint is lack of business partner pull was not conclusively confirmed.

The presence of an *internal champion* seemed to be critical in some cases and in one case when a champion departed the project stalled. In spite of standards being originally seen as strength, the lack of IT industry agreement on the next generation Web Services standards is now emerging as a perceived constraint.

Surprisingly, though Web Services Security was considered important, it was not perceived as a key constraint. The reasons for this seem to be first that many applications remain behind a safe firewall and secondly that even outside the firewall, for some applications security can be handled satisfactorily using network layer (SSL) security so that an enhanced security standard is not essential. Furthermore some respondents felt that *WS-Security* is fast becoming a mature standard and it is already being used in one of the projects studied.

Limitations and Further Research

Though this exploratory investigation has identified some key preliminary findings, due to its exploratory nature it has posed further questions which need to be researched in a more rigorous way. There has been little opportunity to apply rigorous case research validation techniques such as cross case triangulation. (Dubé & Paré, 2003). Some further in depth interviews or focus groups could overcome these limitations. By feeding the issues from this study into a series of focus groups which include some of the respondents from the current study, the validity of these findings could be further assessed.

The fact that the SOA/WS innovations are not yet established as mainstream, offers an opportunity to observe whether and when they do become mainstream and if so to study the maturation of the adoption process over time rather than on a snapshot basis. Though the timescale involved is uncertain, it is likely that an annual follow up of each of the cases over the next 2 or 3 years could reveal much about this timescale and also about the diffusion process.

Another option is to use the exploratory findings to create an instrument for quantitative large sample survey research similar to instruments validated in past DOI studies but focussed on SOA/WS innovations.

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